

A STUDY OF MORPHOLOGY OF TALUS AND ITS CALCANEAL FACETS

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ABSTRACT

Introduction: Of the seven tarsal bones Talus and calcaneum belong to the proximal row. Talus is a peculiar bone with major part of it covered by articular cartilage and devoid of any muscular or tendinous attachment. It has 3 facets anterior, middle and posterior located inferiorly, which articulate with superior facets of calcaneum. The anterior facet is present on the inferior aspect of head and is continuous with its articular surface but usually it is not so with middle articular facet. Various authors have studied morphology of talus and its articular facets across different parts of the world and in different parts of our country but such data was not reported from Andhra region. Hence the study was undertaken.

Materials and Methods: Total 84 tali (40 right and 44 left) of unknown sex, obtained from the department of Anatomy of N.R.I Medical College were studied. Morphometric analysis of talus included measurement of length; breadth and height of individual bone using digital vernier callipers after necessary digital correction. Range, Mean, Standard deviation were calculated. calcaneal facets and their types, squatting facets, extensions of trochlea tali were studied.

Results and Conclusion: Mean length of talus was 5.33 cm; Mean width was 3.79 cm and Mean height was 2.52cm in the present study. In the present study calcaneal facets of talus were classified based on previous studies. The percentage of tali with Type 1 facets was highest followed by type 2 and type 5. Type 4 facets were seen in very few tali Type 3 was rarest. Only one talus on right side had type 3 facets and it was not seen on the left side. Lateral squatting facets were more common on right side but medial and combined facets though less frequent were seen more on left side. Lateral extensions were more commonly seen than medial extensions. The Morphometric measurements of talus in the present study were comparable to all other Indian studies. The variations in the incidence of calcaneal facets, squatting facets and trochlear extensions can be attributed to the racial, genetic, environmental and occupational factors.

KEY WORDS: Sub Talar Joint Stability, Trochlea Tali And Squatting Facets.

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INTRODUCTION

Of the seven tarsal bones, talus and calcaneum belong to the proximal row. Talus is a peculiar bone with major part of it covered by articular cartilage and devoid of any muscular or tendinous attachment [1].

The body of talus (astragalus), bearing a pulley like trochlea tali is separated by a rough neck from the smooth convex head anteriorly. Articular area also seen on lateral and medial aspects of body of talus. A small extension of body behind trochlea tali is posterior process, ends in medial and lateral tubercles separated by groove for flexor hallucis longus. The lateral tubercle when present as separate bone called as os trigonum. Talus has 3 facets inferiorly which articulate with superior facets of calcaneum. The anterior one lies below the head, middle one lies in front and posterior one behind the sulcus tali. The anterior facet is present on the inferior aspect of head and is continuous with its articular surface but usually it is not so with middle articular facet [2].

Classification given by Arora et al [3], Kaur et al [4], Garg et al [5]; Chandra Philip [6] about various types of calcaneal articular facets was followed in the present study.

Type I: Anterior and middle facets completely fused.

Type II: Anterior and middle facets are separated by a ridge.

Type III: Anterior and middle facets are separated partly by a ridge and partly by a groove.

Type IV: Anterior and middle facets are separated completely by a non-articular groove.

In the above 4 types a separate Posterior calcaneal facet was present

Type V: In this type middle facet fuses with posterior facet. The sub types a,b,c were classified based on anterior facet.

Va- Anterior, middle and posterior facets completely fused resulting in a single continuous facet.

Vb- Anterior facet completely separated by a groove from the combined middle and posterior facet.

Vc- Anterior facet separated by a ridge from the

combined middle and posterior facet.

Various authors have studied morphology of talus and its articular facets across different parts of the world and in different parts of our country but such data was not reported from Andhra region. Hence the study was undertaken

MATERIALS AND METHODS

The present study was conducted on talus. Total 84 tali (40 right and 44 left) of unknown sex, obtained from the department of Anatomy of N.R.I Medical College were studied. Morphometric analysis of talus included measurement of length; breadth and height of individual bone. The measurements were taken using digital vernier callipers after necessary digital correction. Range, Mean, Standard deviation were calculated. Types of calcaneal articular facets on the inferior aspect were studied in each talus and were classified according to the classification followed by earlier authors. Photographs were taken where ever necessary. Extensions of trochlea tali and squatting facets were also observed and the frequency with which they occur was recorded.

RESULTS

The following parameters were studied in the present study:

Maximum antero posterior length (L): is the distance between the most anterior and posterior points of the talus. Range of length was from 4.24 cm to 6.63cm.

Maximum transverse width (W): is the maximum distance between the most medial and most lateral points on the body of the talus. Range of width was from 3.09 cm to 4.35cm.

Maximum vertical height (H): is the maximum distance between the most superior and inferior points on the body of the talus. Range of height was from 1.95 cm to 2.95cm.

Table 1: Morphometric measurements of Talus in the present study.

Parameters	Right (40)		Left (44)		Total (84)	
	Mean	S.D	Mean	S.D	Mean	S.D
Max. Length in cm	5.37	0.21	5	0.47	5.33	0.46
Max. Width in cm	3.79	0.29	4	0.31	3.79	0.3
Max. Height in cm	2.51	0.21	3	0.2	2.52	0.2

In the present study, the percentage of tali with

Type 1 facets was highest followed by type 2 and type 5. Type 4 facets were seen in very few tali Type 3 was rarest. Only one talus on right side had type 3 facets and it was not seen on the left side.

Table 2: Incidence of various types of calcaneal facets in the present study.

Type of facet	Right side (n=40) - % (fig :1)	left side (n=44) - % (fig :2)	Total (n=84) - %
Type 1	19 -47.5%	25 - 56.8%	44 -52.4%
Type 2	16 -40%	11- 25%	27- 32.1%
Type 3	1- 2.5%	----	1 - 1.2%
Type 4	2-5%	1-2.3%	2- 3.6%
Type 5	2-5%	7-15.9%	9 -10.7%
Type 5a	2-5%	4 -9.1%	6 -7.14%
Type 5b	--	--	--
Type 5c	--	3 - 6.8 %	3 - 3.57%

Fig. 1: Showing 5 types of calcaneal facets on inferior aspect of right talus.



1-Type 1 anterior and middle facets fused and posterior facet separate.

2-Type 2 anterior and middle facets separated by ridge and posterior facet separate.

3-Type 3 anterior and middle facets separated by ridge and groove with separate posterior facet.

4-Type 4- anterior and middle and posterior facets separately present.

5-Type 5 anterior and middle facets and posterior facets completely fused.

Fig. 2: Showing 4 types of calcaneal facets on inferior aspect of left talus.



1 - Type 1- anterior and middle facets fused and posterior facet separate.

2 - Type 2- anterior and middle facets separated by ridge and posterior facet separate.

4 - Type 4- anterior and middle facets and posterior facets separately present.

5a - Type 5a - anterior , middle and posterior facets completely fused.

5c -Type 5c - anterior and middle facets separated by ridge and fuses with posterior facet.

The incidence of different squatting facets was shown in table 3.

Table 3: Incidence of squatting facets in the present study.

Talus	Lateral squatting facet-%	Medial squatting facet -%	Combined squatting facet -%	Gutter shaped squatting facet -%
Right (40)	27 (67.5%)	1(2.5%)	1(2.5%)	1(2.5%)
Left (44)	20 (45.5%)	10(22.7%)	8(18.2%)	1(2.2%)
Total (84)	47 (56%)	11(13.1%)	9(10.7%)	2(2.4%)

It was observed that on the right sided tali, lateral squatting facets were more common but medial and combined facets were rarely seen. Contrary to that medial and combined facets were more frequently seen in left sided tali.

Lateral extensions were more commonly seen than medial extensions. In 14 out of 40 right tali lateral extension of trochlea tali was found .Medial extension though less frequently seen but was more in left tali 6/44 (13.6%) than right tali 1/40(2.5%). Continuous extensions were not seen in the present study.

DISCUSSION

Table 4: Comparison of morphological parameters on right and left side with previous studies.

Parameter	Ari et al [7]	Gautam et al [8]	Saif Omar et al [9]	Mahato et al [10]	Motagi et.al	Present study
Mean L (Rt) cm	5.72	5.23	5.31	5.57	5.42	5.37
Mean L (Lt) cm	5.64	5.29	5.31	5.58	5.33	5.34
Mean W (Rt) cm	4.91	3.79	4.02	2.9	3.62	3.79
Mean W (Lt) cm	4.69	3.68	4.02	3.03	3.77	3.8
Mean H (Rt) cm	---	---	2.93	---	---	2.51
Mean H (Lt) cm	---	---	2.93	---	---	3

L-length, W-width, H –height

Fragmented remains of long bones more often retain the relevant bony markers due to their large size, but relatively small bones can also preserve these markers and hence can be used by forensic anthropologists and bioarcheologists for estimation of bone length and stature. Accurate estimations and derivations of metric features can be obtained directly from the calcaneus and talus bones since these compact bones are relatively more durable than other bones [7].

The Morphometric parameters taken in the present study were compared with other previous studies in table 4. It was inferred that the measurements obtained in the present study were on par with most of the studies.

According to Bruckner [12] the stability and mobility of sub talar joint is dependent on number of articular facets of talus and calcaneum that have contact with each other. Accordingly higher the number of facets, so is the stability thus making articular tripod the most stable position and single facet morphology the unstable one. Verhagen [13] also supported the above concept as he found that arthritic limping was less common in osseous tripod facet configuration and stressed the subtalar instability in single facet configuration.

Table 5: Comparison of incidence of various types of Calcaneal facets among various Indian studies.

s.no	study	place	% of Type 1	% of Type 2	% of Type 3	% of Type 4	% of Type 5
1	Arora et al [3]	North Indian	16	78	1	3	2
2	Bilodi et al [14]	South Indian	10	50	16	5	18.4
3	Kaur et al [4]	North Indian	45	24	9	5	17
3	Rohin Garg [5]	Rajasthan	39	43.7	6	5.3	6
4	Chandra	Puduchery	42	30	4	3	21
5	Present study	Andhra Pradesh	52	32	1	3.6	10.7

When the incidence of various types of facets among various Indian studies was compared (Table: 5) it was observed that in Chandra Philip [14] study and present study incidence of Type 1 was higher than Type 2 where as in rest of the studies incidence of type 2 was higher than type 1. Type 1 incidence was highest in the present study when compared to all other Indian studies. Type 3 facets were rarest in this study as it was seen only in 1 right talus and absent on left side, similar to the incidence of Arora et al [3]. Type 4 incidence was comparable to all other Indian studies. The incidence of Type 5 was variable among different studies ranging from 2% to 18% and in the present study it was in the intermediate range of 10.7%.

Subtypes of Type 5 where posterior facet is fused with middle facet were classified based on fusion or separation of anterior and middle facets into a, b and c subtypes [6]. In the present study sub type 5a and 5c were found 5 b was not seen. Type 5a was seen in both right and left sides whereas 5c was seen only in left tali. Type 5a incidence in the present study was 7.1% (6/84) whereas in other studies it was kaur et al 8%

[4], garg et al 5% [5] and Chandra Philip et al 10% [6]. Type 5 c was reported only by Chandra Philip [6] to be 2% and in the present study it was 3% (3/84).

In a study conducted in Nepal on 50 tali, Type 4 was not seen and type 5 incidence was highest [15]. In Belgium [16] and Korean studies [17] type 5 was not seen. Type 3 incidence was highest in Koreans when compared with others.

Squatting facets on the distal end of tibia and superior aspect of neck talus that articulate in extreme dorsiflexion developed as an adaptation to squatting habit where as in climbers like orangs also similar facets were well demarcated but developed as an adaptation to climbing [18].

According to Charles [19] inheritance of acquired characters can be explained by the expression of squatting facets on the dorsal surface of the neck of the talus in fetus as well as adults of oriental races.

Presence of squatting facets commonly seen in a tropical country like India can be considered as an adaptation developed as a result of prolonged exposure in squatting posture to meet occupational need such as harvesting or to perform early morning rituals [20].

In the present study lateral squatting facet incidence was more in right tali, medial and combined squatting facets were common on left side, in a study conducted by Rohin Garg et al [21] lateral squatting facet was more commonly seen left tali. Combined squatting facets incidence in the present study (10.7%) was comparable to study conducted by Panday & Singh et al [22] (11.8%), but it was low in other studies by Shilpi et al [23] (2.04%) & Garg et al ; (3.3%) [21]. Gutter shaped facets incidence was lowest in this study (2.38%) and it was (4%) slightly higher in two studies and highest with Panday & singh et al (10.7%) [20].

According to Rohin garg et al [21], trochlear extension was frequent on lateral aspect of right tali. Similar observation was seen in the present study. Incidence of medial extension was similar on both sides in the above study but in this study medial extension though less frequent was comparatively more on left side. Continuous extension was not seen in the present study.

The morphometric measurements of talus in the present study were comparable to all other Indian studies but the variations in the incidence of calcaneal facets, squatting facets and trochlear extensions can be attributed to the racial, genetic, environmental and occupational factors.

CONCLUSION

In the present study the morphometric measurements of talus Mean length, width, height in cms were 5.37, 3.79, 2.51 on the right side and 5.4, 3 on the left side respectively. The percentage of tali with Type 1 facets was highest followed by type 2 and type 5. Type 4 facets were seen in very few tali Type 3 was rarest. Only one talus on right side had type 3 facets and it was not seen on the left side. In the present study sub type 5a and 5c were found 5b was not seen. Lateral squatting facets were more common in the right tali but medial and combined facets though rarely seen were more frequently seen in left tali. Trochlea tali extensions were more commonly seen on lateral aspect than medial side.

Conflicts of Interests: None

REFERENCES

- [1]. Berlet GC. Talar neck fractures. *Orthop Clin North Am* 2001; 32: 53-64.
- [2]. W.Henry Hollinshed, *Anatomy for Surgeons*, volume 3: The back and limbs-Ankle and foot, Pg.833-834.
- [3]. Arora A.K. Gupta.S.C, Gupta C.D. Jeysing.P Variations in Calcaneal articular Facets in Indian Tali- *Anat Anz*, (1979) ,46-377-380.
- [4]. Kaur M, Kalsey G, Laxmi V: Morphological classification of tali on the basis of calcaneal articular facets. *PB Journal of Orthopedics*; 2011; 12(1):57-60.
- [5]. R. Garg, S. Babuta, K. Mogra, R. Parashar, S. Shekhawat, Study of Variations in Pattern of Calcaneal Articular Facets in Human Tali in the Population of Rajasthan (India). *People's Journal of Scientific Research*, July 2013, Vol. 6(2), 18 -23.
- [6]. X Chandra Philip, G Prabavathy, Study of Anatomical Variations of Human Tali Based on Their Calcaneal Articular Facets, *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, September - October 2014, vol: 5(5), 1484-1490.
- [7]. Ari I, Kafa IM. Bone length estimation and population-specific features of calcaneus and talus bones of the late byzantine era. *Coll Antropol*. 2009;33(2): 613-18.
- [8]. Gautham K, Clarista MQ, Sheela N, Vidyashambhava P. Morphometric Analysis of the Human Tali. *CIBTech Journal of Surgery*, 2013; 2(2): 64-68.
- [9]. Saif Omar, Masroor Alam, Ram Bilash Gupta and Khurshid Alam, Bilateral symmetry of the talus: a study on 40 dry adult tali in Bihar, *International Journal of Recent Scientific Research*, April 2015, Vol. 6, Issue, 4, pp.3404-3405,.
- [10]. Mahato NK, Murthy SN. Articular and angular dimensions of the talus: inter-relationship and biomechanical significance. *Foot (Edinb)*. 2012;22:85-9.
- [11]. Manjunath V Motagi, Sugathan R Kottapurath, Kavitarati Dharwadkar, Morphometric analyses of human dry tali of South Indian origin, *International Journal of Medical Science and Public Health*, 2015, Vol 4 (2):237-240.
- [12]. Bruckner JS: Variations in the Human Subtalar Joint; *Journal of Orthopaedic & Sports Physical Therapy*; 1987; 8(10):489-494.
- [13]. Verhagen FD: Arthritis of the subtalar joint associated with sustentaculum tali facet configuration. *Journal of Anatomy*, 1993; 183; 631-634.
- [14]. Bilodi AK, Study of calcaneal articular facets in human tali, *Kathmandu University Medical Journal* 2006, Vol. 4(13), 75-77.
- [15]. Bilodi AK1, Agarwal BK2, Study of fifty human tali for calcaneal articular facets, *Kathmandu University Medical Journal* 2003, Vol. 2(7), 213-215.
- [16]. Barbaix E, Roy PV, Clarys JP: Variations of anatomical elements contributing to subtalar joint stability: intrinsic risk factors for post traumatic lateral instability of the ankle? *Ergonomics*; 2000; 43(10): 1718-1725.
- [17]. Lee JY, Jung MH, Lee JS, Choi BY, Cho BP: Types of calcaneal articular facets of the talus in Korean. *Korean Journal of Physiology Anthropology*, 2012; 25 (4): 185- 192.
- [18]. Thomson A. The influence of posture on the form of the articular surfaces of the tibia and astragalus in the different races of man and the higher apes. *J Anat Physiol* 1889; 23:616-639.
- [19]. Charles RH. Morphological peculiarities in the Punjabi and their bearing on the question of the transmission of acquired characters. *J Anat Physiol* 1894; 28: 271-80.
- [20]. Das AC. Squatting facets of the talus in U.P. subjects. *J Anat Soc India* 1959; 8: 90-92.
- [21]. Rohin Garg, Sushila Shekhawat, Khushboo Mogra, Santosh Kumar, Modifications on Dorsum of Neck of Talus (Squatting Facets and Trochlear Extensions) in Indians, *Acta Medica International* , Jan - Jun 2015;2(1):100-104.
- [22]. Pandey SK, Singh S. Study of squatting facet/extension of talus in both sexes. *Medicine, Science and the Law* 1990; 30 (2): 159-64.
- [23]. Shilpi GD, Kaur J, Kakar S. Racial variation on articular surface of talus (astragalus) in north Indian population. *Journal of Forensic and Legal Medicine* 2012;19:152-157.